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THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants	:	David A. Grilli et al.
Serial No.	:	09/933,534
Filing Date	:	August 20, 2001
For	:	THERMOPLASTIC POLYOLEFIN ELASTOMER STEERING WHEEL
Group Art Unit	:	3682
Examiner	:	B.J. Van Pelt
Attorney Docket No.	:	TRW(AP)5727

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Alexandria, VA 22313-1450

AMENDED APPEAL BRIEF

Sir:

Pursuant to the Office Action dated February 9, 2006, Appellants' present herewith their amended Brief on appeal.

I. REAL PARTY IN INTEREST

The real party in interest is TRW Vehicle Safety Systems Inc., as indicated by the Assignment recorded August 20, 2001, Reel/Frame: 012100/0676.

II. RELATED APPEAL AND INTERFERENCES

There are no related appeals or interferences.

III. STATUS OF CLAIMS

Claims 1, 3, 5-12 and 14-28 are rejected and are appealed.

Claims 2, 4 and 13 are cancelled.

Claims 29-37 are allowed.

IV. STATUS OF AMENDMENTS

Claim 4 was cancelled in a proposed amendment after final dated June 9, 2005.

The proposed amendment was entered for purposes of appeal in an Office Action dated July 27, 2005.

V. SUMMARY OF THE CLAIMED SUBJECT MATTER

The present invention relates to a steering wheel (10) comprising a rim portion (12), a spoke portion (18), and a foamed thermoplastic polyolefin elastomer padding material (14) adhered to the rim portion (12) and the spoke portion (18). (Page 5, lines 16-19; Page 6, lines 7-9). The foamed thermoplastic polyolefin elastomer padding material (18) includes an inner portion (89) and an outer portion (90) substantially covering the rim portion (12) and the spoke portion (18). (Page 24, lines 6-9; Fig. 4). The inner portion (89) has a cellular structure and a substantially uniform cell density. (Page 24, lines 9-11). The outer portion (90) has a continuous external surface free of interruption by a cell. (Page 24, lines 11-12). The foamed thermoplastic polyolefin elastomer padding material comprises a gasified chemical foaming agent and a thermoplastic polyolefin elastomer. (Page 6, lines 12-14). The thermoplastic polyolefin elastomer is weatherable and has a durometer shore A hardness of about 30 to about 90. (Page 6, lines 14-17).

The foamed thermoplastic polyolefin elastomer padding material substantially covering the rim portion can have a first thickness, and the foamed thermoplastic polyolefin

elastomer padding material substantially covering the spoke portion can have a second thickness different from the first thickness. (Page 24, lines 16-24).

The thermoplastic polyolefin elastomer includes a thermoplastic polyolefin polymer selected from the group consisting of polyethylene, polypropylene, polybutylene, polyisobutylene, polyoctene, copolymers of polyethylene, polypropylene, and polybutylene, and mixtures thereof. (Page 7, lines 4-9). The thermoplastic polyolefin elastomer can also include thermoplastic elastomer or rubber. (Page 7, lines 20-23). In an aspect of the invention, the thermoplastic polyolefin elastomer comprises a mixture of ethylene-propylene copolymer, ethylene-propylene-diene terpolymer, and polypropylene. (Page 8, lines 10-14).

The foamed padding material can also be plasticizer-free. (Page 15, lines 12-13). The chemical foaming agent can comprise an exothermic chemical foaming agent, an endothermic chemical foaming agent, or a mixture thereof. (Page 9, lines 12-14). The chemical foaming agent prior to being gasified can be in the form of a plurality of granules that are encapsulated with a resin carrier. (Page 12, lines 11-17). The resin carrier can be essentially the same material as the thermoplastic polyolefin elastomer. (Page 13, lines 21-24). The foamed padding material can further include an additive selected from the group consisting of colorants, inorganic fillers, nucleating agents, and stabilizers.

The present invention also relates to a method of forming a foamed padding material for a steering wheel. The method comprises mixing a thermoplastic polyolefin elastomer and

a chemical foaming agent. (Page 17, lines 4-9). The thermoplastic polyolefin elastomer mixed with the chemical foaming agent is then heated to cause the thermoplastic polyolefin elastomer to melt and the chemical foaming agent to melt. (Page 4; lines 9-11). The heated mixture is injected into a mold that includes a cavity in which a spoke portion and rim portion of a steering wheel armature are received. (Page 17, lines 12-20).

VI. <u>GROUNDS OF REJECTION TO BE REVIEW ON APPEAL</u>

1. Whether claims 1, 3, 5, 8, 11, 19, 20, 21, 22-24, and 27 are obvious over U.S. Patent No. Re. 36,898 (hereinafter, "Sawada et al.") in view of U.S. Patent No. 6,386,579 (hereinafter, "Reidy et al.")?

2. Whether claim 7, 12, 14, 15, 18, and 28 are obvious over Sawada et al. in view of Reidy et al.?

3. Whether claims 9 and 25 are obvious over Sawada et al. in view of Reidy et al. and WO 99/10419 (hereinafter, "Braun et al.")?

4. Whether claims 10 and 26 are obvious over Sawada et al. in view of Reidy et al. and Braun et al.?

5. Whether claim 16 is obvious over Sawada et al. in view of Reidy et al. and Braun et al.?

6. Whether claim 17 is obvious over Sawada et al. in view of Reidy et al. and Braun et al.?

VII. ARGUMENTS FOR CLAIMS 1, 3, 5-12 AND 14-28

A. 35 U.S.C. §103(a) rejection of claims 1, 3, 5, 6, 8 and 11, 19, 20, 21, 22-24, and 27 over Sawada et al. in view of Reidy et al.

Claim 1 recites a steering wheel comprising a rim portion, a spoke portion, and a foamed thermoplastic polyolefin elastomer padding material adhered to the rim portion and the spoke portion. The foamed thermoplastic polyolefin elastomer padding material includes an inner portion and an outer portion substantially covering the rim portion and the spoke portion. The inner portion has a cellular structure and a substantially uniform cell density. The outer portion has a continuous external surface free of interruption by a cell. The foamed thermoplastic polyolefin elastomer padding material comprises a gasified chemical foaming agent and a thermoplastic polyolefin elastomer. The thermoplastic polyolefin elastomer is weatherable and has a durometer shore A hardness of about 30 to about 90.

Claim 1 is patentable over Sawada et al. in view of Reidy et al. because (1) Sawada et al. in view of Reidy et al. do not teach or suggest a foamed thermoplastic polyolefin elastomer padding material that has a durometer shore A hardness of about 30 to about 90 and comprises an inner portion having a cellular structure and a substantially uniform cell density and an outer portion having a continuous external surface free of interruption by a cell, (2) the Office Action provides no motivation to use the thermoplastic polyolefin elastomers in Sawada et al. for the padding material in Reidy et al., and (3) the combined teachings of Sawada et al. and Reidy et al. would still not teach the invention recited in claim 1.

1. Sawada et al. in view of Reidy et al. do not teach or suggest a foamed thermoplastic polyolefin elastomer padding material that has a durometer shore A hardness of about 30 to about 90 and comprises an inner portion having a cellular structure and a substantially uniform cell density and an outer portion having a continuous external surface free of interruption by a cell.

Sawada et al. teach a cover for a vehicle air bag that comprises an injection molded core layer and an injection molded external surface layer. The injected molded external surface layer can be foamed up to 3 times its volume (Column 4, lines 22-24). Sawada et al. do not teach that the external surface layer has a substantially uniform cell density and that it has an outer portion, which is free of interruption by cell. Sawada et al., in fact, say nothing about the structure other than it can be foamed.

Sawada et al. also do not teach that the core layer can comprise a foamed thermoplastic polyolefin elastomer. The core layer, which is referred to as layer 1B, is not foamed as indicated in the Office Action. The only core layer that is foamed is in the comparative examples, and these core layers do not comprise a thermoplastic polyolefin elastomer, but a urethane foam. (Column 8, lines 5-10).

Additionally, as noted in the Office Action, Sawada et al. do not teach substantially covering the rim portion and the spoke portion of a steering wheel. Moreover, there is no suggestion in Sawada et al. to use such a material to cover the rim portion and spoke portion of the steering, or that using such a material to cover a rim portion and spoke portion of a steering wheel is even desirable.

Reidy et al. also do not teach a foamed thermoplastic polyolefin elastomer material that has an inner portion with a substantially uniform cell density and that has an outer portion, which is free of interruption by cell. Reidy et al. teach a padding material comprising a thermoplastic elastomer. Reidy et al. teach that the thermoplastic elastomer can be Arnitel EM 400. As discussed in the background section of the present application and in the Arnitel

reference provided in the IDS, Arnitel EM 400 is not a polyolefin thermoplastic elastomer, but a polyester.

Reidy et al. also teach that thermoplastic elastomers, such as polypropylene can be used for the steering wheel. Reidy et al. however, do not teach that the durometer shore A hardness of a thermoplastic elastomer formed from polypropylene. Additionally, there is no suggestion in Reidy et al. that a thermoplastic elastomer formed from a polypropylene has a durometer Shore A hardness of about 30 to about 90. Moreover, Reidy et al. do not teach that the polypropylene is used in combination with a gasified foaming agent. Additionally, although suggested by Reidy et al., polypropylene is not a thermoplastic elastomer. Polypropylene as defined in Hawley's Condensed Chemical Dictionary (a copy of relevant text attached to response dated June 3, 2003) is a crystalline thermoplastic polymer. It is not a thermoplastic elastomer in and of itself. Polypropylene must be combined with an additional polymer that has amorphous properties to form a thermoplastic elastomer. Therefore, even though Reidy et al. teach that polypropylene is an example of a thermoplastic elastomer, this is not an accurate statement, and thus, Reidy et al. cannot be relied on to teach that a thermoplastic polyolefin elastomer.

Reidy et al. also do not teach a padding material of a thermoplastic polyolefin elastomer with a continuous external surface free of interruption by a cell. Reidy et al., first, only disclose a thermoplastic resin has the structure disclosed in Fig. 4, with an external skin and underlying core. Reidy et al. do not teach that this thermoplastic resin is a thermoplastic polyolefin elastomer. Reidy et al. further do not teach that the padding material has an external surface free of interruption by cell. Referring to Fig. 4 of Reidy et al., which depicts a padding material on a steering wheel, the padding material includes numerous cells across the surface 20 of the padding material. Thus, the external surface of the padding material is not free of interruption by cell.

Thus, Sawada et al. in view of Reidy et al. fail to teach or suggest a thermoplastic polyolefin elastomer with a durometer Shore A hardness of about 30 to about 90 that has an inner portion having a cellular structure and a substantially uniform cell density and an outer portion having a continuous external surface free of interruption by a cell.

2. <u>The Office Action fails to provide a motivation to use the thermoplastic polyolefin elastomers in Sawada et al. for the padding material in Reidy et al.</u>

To establish obviousness based on a combination of the elements disclosed in the prior art, there must be some motivation, suggestion, or teaching of the desirability of making the specific combination that was made by the applicant. <u>*In re* Kotzab</u>, 55 USPQ2d 1313, 1315 (Fed. Cir. 2000). The Office Action provides no motivation, suggestion, or teaching to cover the rim and spoke portion of a steering wheel as taught in Reidy et al. with the thermoplastic polyolefin elastomers taught in Sawada et al.

The Office Action argues that it would be obvious to one of ordinary skill in the art at the time the invention was made to modify the padding of Sawada et al. with the teachings of Reidy et al. so as to provide a cover that is adhered to the spoke and rim portions of the steering wheel to ensure strength and continuity across the steering wheel, while providing good wear characteristics along the rim of the steering wheel.

There is no teaching or suggestion in Sawada et al. and Reidy et al. that a thermoplastic polyolefin elastomer, and particularly, a thermoplastic polyolefin elastomer taught in Sawada et al., when adhered to a spoke or rim potions will "ensure strength and continuity across the steering wheel, while providing good wear characteristics along the rim of the steering wheel," as argued in the Office Action.

Sawada et al. is only concerned with selecting polymers to form a cover that has a "surface that is soft and comfortable to the touch... and that is easily broken in a controlled

manner when the air bag inflates." (Column 1, lines 66-67, column 2, lines 1-10). There is no suggestion in Sawada et al. that a thermoplastic polyolefin elastomer will have good wear characteristics when used along the rim or spoke of a steering wheel or that a polymer, which can be easily broken, can be used to cover a rim and spoke portion of a steering wheel. Likewise, Reidy et al. do not teach or suggest that a thermoplastic polyolefin elastomer, such as a thermoplastic polyolefin elastomer, will have good wear characteristics when used along the rim or spoke of a steering wheel or that a polymer, which can be easily broken, can be used to cover a rim and spoke portion of a steering wheel. In fact, Reidy et al. states that the "prior art does not identify a single thermoplastic material that will yield the necessary physical characteristics of for both the rim portion of a steering wheel and the portion of the steering wheel that will function as an air bag cover." (Column 3, lines 41-45).

Accordingly, the Office Action's motivation to combine the teaching of Reidy et al. and Sawada et al. are at best speculation and conjecture. Speculation and conjecture, however, are not sufficient for establishing a prima facie case of obviousness. In re Warner, 379 F.2d 1011, 1017, 154 USPQ 173, 178 (CCPA 1967).

Thus, nothing in the prior art references of record suggests the desirability of using a foamed thermoplastic polyolefin elastomer to cover a steering wheel spoke and rim portion. Therefore, the motivation for the combination of Sawada et al. and Reidy et al. relied upon in the rejection of claim 1 could only have arisen from hindsight reconstruction, which is impermissible. Heidelberger Druckmaschinen AG *v.* Hantscho Commercial Products, Inc., 30 USPQ2d 1377, 1380 (Fed. Cir. 1993).

The teachings of the prior art must be viewed without benefit of the applicants' disclosure and must in and of themselves make the invention as a whole obvious to one of ordinary skill in the art. *See In re* Sponnoble, 160 USPQ 237, 243 (CCPA 1969). Therefore, the patents relied upon in the rejection of claim 1 do not in and of themselves provide

teachings, which would have made the features of claim 1, as a whole, obvious to one of ordinary skill in the art.

3. The combined teachings of Sawada et al. and Reidy et al. would still not teach the invention recited in claim 1.

Assuming arguendo, that there was a motivation to combine the teachings of Sawada et al. and Reidy et al., the combined teachings of Sawada et al. and Reidy et al. would still not teach the invention recited in claim 1. As discussed above, Sawada et al. do not teach a foamed thermoplastic polyolefin elastomer that has an inner portion having a cellular structure and a substantially uniform cell density and an outer portion having a continuous external surface free of interruption by a cell. Thus, if one was to provide the thermoplastic polyolefin elastomer of Sawada et al. over the rim and spoke portion of the steering wheel as taught in Reidy et al., the thermoplastic polyolefin elastomer would still not include an inner portion having a cellular structure and a substantially uniform cell density and an outer portion having a continuous external surface free of interruption by a cell.

Claims 3, 5, 6, 8 and 11 depend either directly or indirectly from claim 1 and therefore are allowable because of the aforementioned deficiencies in rejection with respect to claim 1 and because of the specific limitations recited in claims 3, 5, 6, 8 and 11.

Claim 19 recites similar limitations as claim 1, and there fore should be allowed because of the aforementioned deficiencies discussed in the rejection with respect to claim 1.

Claims 20, 21, 22-24 and27 depend either directly or indirectly from claim 19 and therefore are allowable because of the aforementioned deficiencies in the rejection with respect to claim 19 and because of the specific limitations recited in claims 20, 21, 22-24 and 27.

B. 35 U.S.C. §103(a) rejection of claims 7, 12, 14, 15, 18, and 28 over Sawada et al. in view of Reidy et al.

Claim 7 depends from claim 1 further recites that the foamed padding material is plasticizer-free. Claim 12 includes limitations similar to claim 1 and also recites that the padding material is plasticizer free. Claim 28 depends from claim 19 and also recites that the padding material is plasticizer-free.

Claims 7, 12, and 28 are patentable over Sawada et al. in view of Reidy et al. because, as discussed with respect to claim 1, (1) Sawada et al. in view of Reidy et al. do not teach or suggest a foamed thermoplastic polyolefin elastomer padding material that has a durometer shore A hardness of about 30 to about 90 and comprises an inner portion having a cellular structure and a substantially uniform cell density and an outer portion having a continuous external surface free of interruption by a cell, (2) the Office Action provides no motivation to use the thermoplastic polyolefin elastomers in Sawada et al. for the padding material in Reidy et al., and (3) the combined teachings of Sawada et al. and Reidy et al. would still not teach the invention recited in claim 1.

Additionally, claim 7 and 12 are patentable over Sawada et al. in view of Reidy et al. because Sawada et al. teach away from a plasticizer-free padding material.

Sawada et al. teach including a plasticizer in the polyolefin elastomer. Sawada et al. state that a hydrocarbon based rubber softener, such as paraffin-based oil or napthene-based oil can be used as a softener to obtain the desired softness of the surface layers. (Column 3, lines 23-26). Sawada et al. further states that the content of the rubber based softener should not exceed 30% by weigh and should preferably be included in an amount of more than 3%. (Column 3, lines 51-63). A rubber softener is a plasticizer. Thus, Sawada et al. teach using a plasticizer in combination with thermoplastic polyolefin elastomer, and therefore teach away from the invention recited in claim 7, 12, and 28.

The Examiner argues that Reidy et al. teach omitting plasticizers as they can migrate to the surface of the padding and cause adhesion problems with paints. This teaching in

Reidy is provided at column 2, lines 5-8 and relates to plasticizers used in PVC. Reidy et al., however, do not teach or suggest plasticizer migration is a problem with thermoplastic polyolefin elastomers or if thermoplastic polyolefin elastomer are used that they should be plasticizer-free.

Thus, Sawada et al. in view of Reidy et al. fail to teach or suggest a plasticizer-free padding. Therefore, claims 7, 12, and 28 are allowable because of the aforementioned deficiencies in the rejection with respect to claim 1 and because Sawada et al. in view or Reidy et al. do not teach or suggest a padding material that is plasticizer-free.

Claims 14, 15, and 18 depend directly from claim 12 and therefore are allowable because of the aforementioned deficiencies in rejection with respect to claim 12 and because of the specific limitations recited in claims 14, 15, and 18.

C. 35 U.S.C. §103(a) rejection of claims 9 and 25 over Sawada et al. in view of Reidy et al. and Braun et al.

Claim 9 depends from claim 1 further recites that the chemical foaming agent prior to be gasified is in the form of a plurality of granules that are encapsulated in a resin carrier. Claim 25 depends indirectly from claim 19, which includes limitations similar to claim 1. Claim 25 also recites that the chemical foaming agent is in the form of a plurality of granules that are encapsulated with a resin carrier.

Claims 9 and 25 are patentable over Sawada et al. in view of Reidy et al. and Braun et al. because, as discussed with respect to claim 1, (1) Sawada et al. in view of Reidy et al. do not teach or suggest a foamed thermoplastic polyolefin elastomer padding material that has a durometer shore A hardness of about 30 to about 90 and comprises an inner portion having a cellular structure and a substantially uniform cell density and an outer portion having a continuous external surface free of interruption by a cell, (2) the Office Action provides no motivation to use the thermoplastic polyolefin elastomers in Sawada et al. for the padding

material in Reidy et al., and (3) the combined teachings of Sawada et al. and Reidy et al. would still not teach the invention recited in claim 1.

Additionally, claims 9 and 25 are patentable over Sawada et al. in view of Reidy et al. and Braun et al. because the Office Action provides no motivation to use the expanded polyolefin particles taught in Braun et al. in the thermoplastic elastomers taught Sawada et al.

The Office Action argues that Braun et al. disclose it is known in the art to provide an impregnated polyolefin granule containing a foaming agent, therefore it would be obvious to one of ordinary skill in the art to provide the foaming agent of the reference combination set forth within a capsule, as taught by Braun et al. in order to avoid "contamination of the surroundings."

There is no suggestion in Braun et al. that an impregnated polyolefin granule will avoid contamination of surroundings. Additionally, Sawada et al. do not teach or suggest that contamination of surroundings is a problem associated with the thermoplastic polyolefin elastomers disclosed in Sawada et al.

Accordingly, the Office Action's motivation to combine the teaching of Braun et al. and Sawada et al. are at best speculation and conjecture. Speculation and conjecture, however, are not sufficient for establishing a prima facie case of obviousness. In re Warner, 379 F.2d 1011, 1017, 154 USPQ 173, 178 (CCPA 1967).

Thus, neither Braun et al. nor Sawada et al. suggests the desirability of using an impregnated polyolefin granule in the thermoplastic elastomer of Sawada et al. Therefore, the motivation for the combine the teachings relied upon in the rejections could only have arisen from hindsight reconstruction, which is impermissible. Heidelberger Druckmaschinen AG *v.* Hantscho Commercial Products, Inc., 30 USPQ2d 1377, 1380 (Fed. Cir. 1993). Therefore, the patents relied upon in the rejection of claims 9 and 25 do not in and of themselves provide teachings, which would have made the features of claims 9 and 25, as a whole, obvious to one of ordinary skill in the art.

D. 35 U.S.C. §103(a) rejection of claims 10 and 26 over Sawada et al. in view of Reidy et al. and Braun et al.

Claims 10 depends from claim 9 further recites that the resin carrier is essentially the same material as the thermoplastic polyolefin elastomer used to form the foamed padding material. Claim 26 depends from claim 25 and also recites that the resin carrier is essentially the same material as the thermoplastic polyolefin elastomer used to form the foamed padding material.

Claims 10 and 26 are patentable over Sawada et al. in view of Reidy et al. and Braun et al. because, as discussed with respect to claim 1, (1) Sawada et al. in view of Reidy et al. do not teach or suggest a foamed thermoplastic polyolefin elastomer padding material that has a durometer shore A hardness of about 30 to about 90 and comprises an inner portion having a cellular structure and a substantially uniform cell density and an outer portion having a continuous external surface free of interruption by a cell, (2) the Office Action provides no motivation to use the thermoplastic polyolefin elastomers in Sawada et al. for the padding material in Reidy et al., and (3) the combined teachings of Sawada et al. and Reidy et al. would still not teach the invention recited in claim 1.

Additionally, as discussed with respect to claims 9 and 25, the Office Action provides no motivation to combine the teaching of Sawada et al. and Braun et al.

Further, claims 10 and 26 are patentable over Sawada et al. in view of Reidy et al. and Braun et al. because Sawada et al. in view of Reidy et al. and Braun et al. fail to teach or suggest that the resin carrier is essentially the same material as the thermoplastic polyolefin elastomer used to form the foamed padding material. There nothing in any of the references that provides a teaching of this limitation, and the Examiner does not address this point in the Office Action. Therefore, the patents relied upon in the rejection of claims 10 and 26 do not

in and of themselves provide teachings, which would have made the features of claims 10 and 26, as a whole, obvious to one of ordinary skill in the art.

E. 35 U.S.C. §103(a) rejection of claim 16 over Sawada et al. in view of Reidy et al. and Braun et al.

Claims 16 depends from claim 15 further recites that the chemical foaming agent prior to be gasified is in the form of a plurality of granules that are encapsulated in a resin carrier.

Claim 16 is patentable over Sawada et al. in view of Reidy et al. and Braun et al. because, as discussed with respect to claim 1, (1) Sawada et al. in view of Reidy et al. do not teach or suggest a foamed thermoplastic polyolefin elastomer padding material that has a durometer shore A hardness of about 30 to about 90 and comprises an inner portion having a cellular structure and a substantially uniform cell density and an outer portion having a continuous external surface free of interruption by a cell, (2) the Office Action provides no motivation to use the thermoplastic polyolefin elastomers in Sawada et al. for the padding material in Reidy et al., and (3) the combined teachings of Sawada et al. and Reidy et al. would still not teach the invention recited in claim 1.

Additionally, claim 16 is patentable over Sawada et al. in view of Reidy et al. and Braun et al. because, as discussed above with respect to claim 12, Sawada et al. teach away from a plasticizer-free padding material.

Further, claim 16 is patentable over Sawada et al. in view of Reidy et al. and Braun et al. because the Office Action provides no motivation to use the expanded polyolefin particles taught in Braun et al. in the thermoplastic elastomers taught Sawada et al.

The Office Action argues that Braun et al. disclose it is known in the art to provide an impregnated polyolefin granule containing a foaming agent, therefore it would be obvious to one of ordinary skill in the art to provide the foaming agent of the reference combination set

forth within a capsule, as taught by Braun et al. in order to avoid "contamination of the surroundings."

There is no suggestion in Braun et al. that an impregnated polyolefin granule will avoid contamination of surroundings. Additionally, Sawada et al. do not teach or suggest that contamination of surroundings is a problem associated with the thermoplastic polyolefin elastomers disclosed in Sawada et al.

Accordingly, the Office Action's motivation to combine the teaching of Braun et al. and Sawada et al. are at best speculation and conjecture. Speculation and conjecture, however, are not sufficient for establishing a prima facie case of obviousness. In re Warner, 379 F.2d 1011, 1017, 154 USPQ 173, 178 (CCPA 1967).

Thus, neither Braun et al. nor Sawada et al. suggests the desirability of using an impregnated polyolefin granule in the thermoplastic elastomer of Sawada et al. Therefore, the motivation for the combine the teachings relied upon in the rejections could only have arisen from hindsight reconstruction, which is impermissible. Heidelberger Druckmaschinen AG *v.* Hantscho Commercial Products, Inc., 30 USPQ2d 1377, 1380 (Fed. Cir. 1993). Therefore, the patents relied upon in the rejection of claim 16 do not in and of themselves provide teachings, which would have made the features of claim 16, as a whole, obvious to one of ordinary skill in the art.

F. 35 U.S.C. §103(a) rejection of claim 17 over Sawada et al. in view of Reidy et al. and Braun et al.

Claims 17 depends from claim 16 further recites that the resin carrier is essentially the same material as the thermoplastic polyolefin elastomer used to form the foamed padding material.

Claim 17 is patentable over Sawada et al. in view of Reidy et al. and Braun et al. because, as discussed with respect to claim 1, (1) Sawada et al. in view of Reidy et al. do not

teach or suggest a foamed thermoplastic polyolefin elastomer padding material that has a durometer shore A hardness of about 30 to about 90 and comprises an inner portion having a cellular structure and a substantially uniform cell density and an outer portion having a continuous external surface free of interruption by a cell, (2) the Office Action provides no motivation to use the thermoplastic polyolefin elastomers in Sawada et al. for the padding material in Reidy et al., and (3) the combined teachings of Sawada et al. and Reidy et al. would still not teach the invention recited in claim 1.

Additionally, as discussed with respect to claims 16, the Office Action provides no motivation to use the expanded polyolefin particles taught in Braun et al. in the thermoplastic elastomers taught Sawada et al.

Further, claim 17 is patentable over Sawada et al. in view of Reidy et al. and Braun et al. because Sawada et al. in view of Reidy et al. and Braun et al. fail to teach or suggest that the resin carrier is essentially the same material as the thermoplastic polyolefin elastomer used to form the foamed padding material. There nothing in any of the references that provides a teaching of this limitation and the Examiner does not address this point in the Office Action. Therefore, the patents relied upon in the rejection of claim 17 do not in and of themselves provide teachings, which would have made the features of claim 17, as a whole, obvious to one of ordinary skill in the art.

VIII. APPENDIX

The attached Appendix contains a copy of the claims on appeal.

Please charge any deficiency or credit any overpayment in the fees for this Appeal Brief to Deposit Account No. 20-0090.

Respectfully submitted,

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VIII. CLAIMS APPENDIX

Claim 1. A steering wheel comprising a rim portion, a spoke portion, and a foamed thermoplastic polyolefin elastomer padding material adhered the rim portion and the spoke portion, the foamed thermoplastic polyolefin elastomer padding material including an inner portion and an outer portion substantially covering the rim portion and the spoke portion, the inner portion having a cellular structure and a substantially uniform cell density, the outer portion having a continuous external surface free of interruption by a cell, and the foamed thermoplastic polyolefin elastomer padding material comprising a gasified chemical foaming agent and a thermoplastic polyolefin elastomer wherein the thermoplastic polyolefin elastomer is weatherable and has a durometer shore A hardness of about 30 to about 90.

Claim 3. The steering wheel of claim 1, wherein the thermoplastic polyolefin elastomer includes a thermoplastic polyolefin polymer selected from the group consisting of polyethylene, polypropylene, polybutylene, polyisobutylene, polyoctene, copolymers of polyethylene, polypropylene, and polybutylene, and mixtures thereof.

Claim 5. The steering wheel of claim 3, wherein the thermoplastic polyolefin elastomer further includes another thermoplastic elastomer or rubber.

Claim 6. The steering wheel of claim 1, wherein the thermoplastic polyolefin elastomer comprises a mixture of ethylene-propylene copolymer, ethylene-propylene-diene terpolymer, and polypropylene.

Claim 7. The steering wheel of claim 1 wherein the foamed padding material is plasticizer-free.

Claim 8. The steering wheel of claim 1, said chemical foaming agent comprises an exothermic chemical foaming agent, an endothermic chemical foaming agent, or a mixture thereof.

Claim 9. The steering wheel of claim 1, wherein the chemical foaming agent prior to being gasified is in the form of a plurality of granules that are encapsulated with a resin carrier.

Claim 10. The steering wheel of claim 9, wherein the resin carrier is essentially the same material as the thermoplastic polyolefin elastomer.

Claim 11. The steering wheel of claim 1 wherein the foamed padding material further includes an additive selected from the group consisting of colorants, inorganic fillers, nucleating agents, and stabilizers.

Claim 12. A steering wheel comprising a rim portion, a spoke portion, and a plasticizer-free foamed thermoplastic polyolefin elastomer padding material substantially covering said rim portion and said spoke portion, said foamed thermoplastic polyolefin elastomer padding material substantially covering said rim portion having a first thickness and said foamed thermoplastic polyolefin elastomer padding material substantially covering said spoke portion having a second thickness different from said first thickness, said foamed thermoplastic polyolefin elastomer padding material including an inner portion and an outer portion, said inner portion having a cellular structure and a substantially uniform cell density,

said outer portion having a continuous external surface free of interruption by a cell, and said foamed thermoplastic polyolefin elastomer padding material comprising a gasified chemical foaming agent and a thermoplastic polyolefin elastomer wherein the thermoplastic polyolefin elastomer is weatherable and has a durometer shore A hardness of about 30 to about 90.

Claim 14. The steering wheel of claim 12, wherein the thermoplastic polyolefin elastomer comprises a mixture of ethylene-propylene copolymer, ethylene-propylene-diene terpolymer, and polypropylene.

Claim 15. The steering wheel of claim 12, wherein said chemical foaming agent comprises an exothermic chemical foaming agent, an endothermic chemical foaming agent, or a mixture thereof.

Claim 16. The steering wheel of claim 15, wherein the chemical foaming agent prior to being gasified is in the form of a plurality of granules that are encapsulated with a resin carrier.

Claim 17. The steering wheel of claim 16, wherein the resin carrier is essentially the same material as the thermoplastic polyolefin elastomer.

Claim 18. The steering wheel of claim 12 wherein the foamed padding material further includes an additive selected from the group consisting of colorants, inorganic fillers, nucleating agents, and stabilizers.

Claim 19. A method of manufacturing a foamed padding material for a steering wheel, said method comprising the steps of:

mixing a thermoplastic polyolefin elastomer and a chemical foaming agent, wherein the thermoplastic polyolefin elastomer is weatherable and has a durometer shore A hardness of about 30 to about 90;

foaming said thermoplastic polyolefin elastomer with said chemical foaming agent;

providing a steering wheel armature having a rim portion and a spoke portion; and

substantially covering said rim portion and said spoke portion of said steering wheel armature with said foamed thermoplastic polyolefin elastomer, said foamed thermoplastic polyolefin elastomer being adhered to said rim portion and spoke portion of said steering wheel armature and forming a foamed padding material including a first portion and a second portion, said first portion having cellular structure and a substantially uniform cell density, said second portion having an external surface free of interruption by a cell.

Claim 20. The method of claim 19 wherein said foamed thermoplastic polyolefin elastomer substantially covering said rim portion and said spoke portion of said steering wheel armature by molding said foamed thermoplastic polyolefin elastomer to said rim portion and said spoke portion of said steering wheel armature.

Claim 21. The method of claim 19 wherein said thermoplastic polyolefin elastomer is foamed by heating said mixture of thermoplastic polyolefin elastomer and chemical foaming agent to a temperature above the melting temperature of said thermoplastic polyolefin elastomer.

Claim 22. The method of claim 19, wherein said thermoplastic polyolefin elastomer is weatherable and has a durometer shore A hardness of about 30 to about 90.

Claim 23. The method of claim 19, wherein the thermoplastic polyolefin elastomer comprises a mixture of ethylene-propylene copolymer, ethylene-propylene-diene terpolymer, and polypropylene.

Claim 24. The method of claim 19, wherein said chemical foaming agent comprises an exothermic chemical foaming agent, an endothermic chemical foaming agent, or a mixture thereof.

Claim 25. The method of claim 24 wherein said chemical foaming agent is in the form of a plurality of granules that are encapsulated with a resin carrier.

Claim 26. The method of claim 25, wherein the resin carrier is essentially the same material as the thermoplastic polyolefin elastomer.

Claim 27. The method of claim 20, wherein said foamed thermoplastic polyolefin elastomer is molded to said steering wheel by injection molding.

Claim 28. The method of claim 19, wherein said foamed padding material is plasticizer-free.

IX. EVIDENCE APPENDIX

1. Hawley's Condensed Chemical Dictionary, 12th ed. pages 454, 455, 940, 941 (1993) submitted by the Applicants' attorney in the June 3, 2003 amendment and entered in the August 15, 2003 Office Action by the Examiner.
2. Textbook of Polymer Science, 3d ed. Page 379, (1984), submitted by the Applicants' attorney in the June 3, 2003 amendment and entered in the August 15, 2003 Office Action by the Examiner.

X. RELATED PROCEEDINGS APPENDIX

There are no related proceedings.

TEXTBOOK OF POLYMER SCIENCE

THIRD EDITION

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'e similar to those of natural rubber.
n obtaining high tensile strength.
wever, until higher elongations are
good and is retained well at high
natural rubber. The electrical prop-
olar, saturated nature. The dynamic
sluggishness over the temperature
mer with high internal friction and
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r produced is used for inner tubes
when tubeless passenger tires were
nonpassenger tires still use tubes.
nechanical goods.
States was about 290 million lb in

polymers and copolymers of chlo-
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narily known for their oil resistance,
n replace natural rubber in most of
of applications. About 270 million

ldition of hydrogen chloride to vi-
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t entirely in the *trans*-1,4 form. As
ners.
rom that of other elastomers in that
d magnesium oxide are the preferred
ey cause crosslinking is not known.
the usual rubber accelerators are in
t retarders of the cure. A few chem-
n, however, among them antimony

Unlike many other elastomers, neoprene vulcanizates have high tensile strength (3500–4000 psi) in the absence of carbon black. No reinforcing effect is found with any filler. Suitably protected neoprene vulcanizates are extremely resistant to oxidative degradation. Weathering resistance and ozone resistance are quite good. Neoprene is slightly inferior to nitrile rubber in oil resistance, but markedly better than natural rubber, butyl, or SBR. The dynamic properties of neoprene are superior to those of most other synthetics and only slightly inferior to those of natural rubber. They are less affected by elevated temperature than those of natural rubber. Neoprene has been shown to make excellent tires but cannot compete with other elastomers in price. Its major uses include wire and cable coatings, industrial hoses and belts, shoe heels, and solid tires. Gloves and eoated fabrics are made from neoprene latex.

Thermoplastic Elastomers

The term *thermoplastic elastomers* is currently used to describe a wide variety of materials that have elastomeric properties at ambient temperatures, but process like thermoplastics, obviating the need for the vulcanization step to develop typical rubberlike elasticity. The best known and most widely used thermoplastic elastomers, to which the name originally applied, are block copolymers of styrene (S) with butadiene (B) or isoprene (I) with the block structure S–B–S or S–I–S. The morphology and properties of these materials are described in Chapter 17*D*. Other polymers commonly termed thermoplastic elastomers are polyurethanes and copolyesters (Chapter 15) and blends of ethylene-propylene copolymers (Section *C*) with polypropylene.

As a family, the thermoplastic elastomers are beginning to replace other specialty rubbers in a wide variety of uses, for example, replacing neoprene in adhesives and wire and cable insulation. Including all types, about 400 million lb was sold in 1982.

Other Elastomers

Several other elastomers have the status of specialty rubbers, at relatively low production volume and high price. Among these are chlorosulfonated polyethylene (Section *C*), the acrylate and various fluorocarbon elastomers (Chapter 14), polyurethane and polysulfide elastomers (Chapter 15), and silicone and epichlorhydrin rubbers (Chapter 16).

GENERAL REFERENCES

Buckley 1965; Friedlander 1965; Hargreaves 1965; Kennedy 1968–1969; Brydson 1978, Chapters 10, 11, and 17; West 1978; Baldwin 1979; Finelli 1979; Johnson 1979*b*; McGrath 1979; Bonk 1982; Ellerstein 1982; Blackley 1983.

Hawley's

Condensed Chemical

Dictionary

TWELFTH EDITION

Revised by

ichard J. Lewis, Sr.

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In affectionate memory of Alberta Gordon for her 50 years of dedicated help to many authors, including this one. Alberta edited this work and all eight editions of *Dangerous Properties of Industrial Materials*. She was recognized professionally for her work and personally by the authors she helped. Alberta will be missed.

In memory of George R. W. Lewis and Allen A. Ross; both had a lifelong interest in science facts.

Special thanks to Geraldine Albert, Craig Little, and Patti Brecht for expediting the editing of this manuscript on a tight schedule.

1-eicosanol. See arachidyl alcohol.

5,8,11,14-eicostetraenoic acid. See arachidonic acid.

eigenenergy. Quantity of energy corresponding to a time-invariant atomic state.

eigenfunction. Wave function corresponding to a state with a definite value of some quantity.

Eigen, Manfred. (1927–). A German physicist who won the Nobel prize for chemistry in 1967. His research concerned the rate of hydrogen-ion formation through disassociation of water. He also was concerned with enzyme control. He received his degree at the University of Gottingen.

Einhorn-Brunner reaction. Formation of substituted 1,2,4-triazoles by condensation of hydrazines or semicarbazides with diacylamines in the presence of acid catalysts.

einstein. The energy acquired by a gram-molecular weight of a substance when each molecule absorbs a quantum of excitation energy.

einsteinium. Es. A synthetic radioactive element with atomic number 99 and aw 253, discovered in the debris from the 1952 hydrogen-bomb explosion. Einsteinium has since been prepared in a cyclotron by bombarding uranium with accelerated nitrogen ions, in a nuclear reactor by irradiating plutonium or californium with neutrons, and by other nuclear reactions. The element is named for Albert Einstein. It has chemical properties similar to those of the rare-earth metal holmium. Isotopes are known with mass numbers ranging from 246 to 253. Einsteinium has a valence of 2, and the lowest heat of vaporization of any divalent element.
See also actinide series.

eka-. Prefix referring to element in next lower position in the same group in the periodic system.

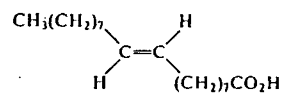
ekahafnium. One of the last-discovered transuranic elements; atomic number 104. It has two α-emitting isotopes (257 and 259) and possibly a third (258). The former, made by bombardment of californium-249 with carbon-12 nuclei, has a half-life of five seconds and decays into nobelium-253. The 259 isotope, made by merging a carbon-13 nucleus with californium-249, has a half-life of three seconds and decays to nobelium-255.

"Ekonol" [*Carborundum*]. TM for an engineering plastic composed of poly-p-oxybenzoate. Resistant to temperatures above 600C, self-lubricating surface.
Use: In pumps handling corrosive liquids, protective coating for titanium skins on supersonic transports, disk brakes, etc.

"ELA" [*Du Pont*]. Brand name for elastomer lubricating agent, a mixture of phosphate esters. Light amber liquid.
Use: Unvulcanized rubbers.

elaboration. A term used in biochemistry to describe chemical transformations within an organism resulting in formation of specific types of substances; e.g., plants elaborate proteins and fats, and poisonous snakes elaborate their venom. It also refers to formation of metabolic end products such as purines and uric acid.

elaidic acid. (trans-9-octadecenoic acid). $CH_3[CH_2]_7HC{:}CH[CH_2]_7COOH$. The trans form of an unsaturated fatty acid of which the cis form is oleic acid.



Properties: White solid, d 0.8505 (79/4C), mp 43.7C, bp 288C (100 mm Hg), 234C (15 mm Hg), refr index 1.4358 (79C). Insoluble in water; soluble in alcohol, ether, benzene, and chloroform. Combustible.
Derivation: Synthesized from oleic acid by elaidinization.
Grade: Purified, 99+%.
Use: Medical research, reference standard in chromatography.

elaidinization. Originally the reaction by which oleic acid is converted into elaidic acid, but now used in a more general sense to indicate the conversion of any unsaturated fatty acid or related compound from the geometric cis to the corresponding trans form. Nitrous acid and selenium compounds are commonly used as catalysts for this reaction. The resulting trans acids are more stable to oxidation.

elasticity. The ability of a material to recover its original shape partially or completely after the deforming force has been removed. The small amount of deformation that is not recovered is called permanent set or permanent elongation. Among common materials glass and some metals are virtually 100% elastic, whereas vulcanized rubber and other elastomeric substances are in the range of 90% elastic after extension to rupture. So-called perfect elasticity is a property of atoms which show no energy loss on collision.
See also modulus of elasticity, stress, strain, plasticity.

elastic modulus. See modulus of elasticity.

elastin. A scleroprotein which occurs in connective tissue.
Properties: Yellow, fibrous mass; insoluble in water, dilute acids, alkalies, and salt solutions, and alcohol. Is partially digested by pepsin solution and wholly by trypsin.

elastomer. As originally defined by Fisher (1940), this term referred to synthetic thermosetting high polymers having properties similar to those of vulcanized natural rubber, namely, the ability to be stretched to at least twice their original length and to retract very rapidly to approximately their original length when released. Among the better known elastomers introduced since the 1930s are styrene-butadiene copolymer, polychloroprene (neoprene), nitrile rubber, butyl rubber, polysulfide rubber ("Thiokol"), cis-1,4-polyisoprene, ethylene-propylene terpolymers (EPDM rubber), silicone rubber, and polyurethane rubber. These can be cross-linked with sulfur, peroxides, or similar agents. The term was later extended to include un-cross-linked polyolefins that are thermoplastic; these are generally known as TPO rubbers. Their extension and retraction properties are notably different from those of thermosetting elastomers, but they are well adapted to such specific uses as wire and cable coating, automobile bumpers, vibration dampers, and specialized mechanical products.

"Elbasols" [*Holliday*]. TM for solvent dyes.
Use: In the coloration of plastics.

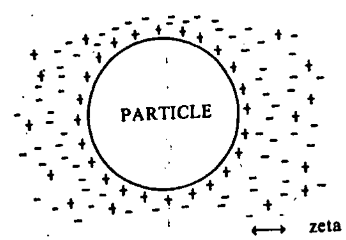
"Elbecrons" [*Holliday*]. TM for disperse dyes.
Use: Mainly on triacetate and polyester materials.

"Elbenyls" [*Holliday*]. TM for selected acid dyes.
Use: On nylon materials.

Elbs persulfate oxidation. Hydroxylation of phenols to p-diphenols by potassium persulfate in alkaline solution.

Elbs reaction. Formation of anthracenes by intramolecular condensation of diaryl ketones containing a methyl or methylene substituent adjacent to the carbonyl group.

electric double layer. A diffuse aggregation of positive and negative electric charges surrounding a suspended colloidal particle which aids in maintaining its stability. According to the Gouy-Freundlich theory, advanced about 1920, a close-packed array of charges is attached to the surface of the particle while a diffuse layer of charges of opposite sign extends into the liquid. The particle is electrically neutral. There is an electrokinetic potential gradient across the double layer that is called the zeta potential. The diagram is an approximation of this phenomenon. Modifications of this theory have been introduced in recent years, notably by Derjaguin and Landau and by Verwey and Overbeek (DLVO theory).
See also zeta potential.



zeta potential

electric furnace. See furnace.

electric steel. Steel made in an electric furnace.

electric vehicle propulsion. See storage battery.

electride. An experimental compound composed of an alkali-metal cation and an electron in which the electron functions as a chemical element (e.g., a halogen) in salt formation. Several such compounds have been made in the U.S. and abroad. The phenomenon is reported to be one which challenges accepted concepts of compound formation.

electrochemical equivalent. The number of grams of an element or group of elements liberated by the passage of one coulomb of electricity (one ampere for one second).

Electrochemical Society. (ECS). Established in 1902, this society was organized to promote the advance of the science of electrochemistry and related fields. It comprises 11 divisions, each devoted to a special branch of electrochemistry, e.g., corrosion, batteries, rare metals, electrode-position, etc. It publishes a journal and sponsors books relating to its major interests. Its office is at 10 S. Main St., Pennington, NJ 08534.

electrochemistry. That branch of chemistry concerned primarily with the relationship between electrical forces and chemical reactions. This re-

"Polyphos" [*Olin*]. TM for a water-soluble glassy sodium phosphate of standardized composition ($Na_{12}P_{10}O_{31}$) analyzing 63.5% P_2O_5 (ratio of Na_2O:P_2O_5 is 1.2:1). It is closely similar to a sodium hexametaphosphate and sodium tetraphosphate; frequently the three names are used interchangeably.
Grade: Ground, walnut-size to pea-size lumps.
Use: Boiler water compounds, detergents, textiles, leather tanning, photographic film developing, deflocculation of clays, flotation and desliming of minerals, dispersion of pigments, paper processing, industrial and municipal water treatment.

polyphosphazene. See phosphazene.

polyphosphoric acid. $H_{n+2}P_nO_{3n+1}$, for $_n$ greater than 1. Any of a series of strong acids, from pyrophosphoric acid, $H_4P_2O_7$ ($_n$ = 2), through metaphosphoric acid (large values of $_n$).
Properties: Viscous, water-white liquid; water-soluble; does not crystallize on standing; hygroscopic. The commercial acid is a mixture of orthophosphoric acid with pyrophosphoric, triphosphoric, and higher acids and is sold on the basis of its calculated content of H_3PO_4 e.g., 115%. Superphosphoric acid is a similar mixture sold at 105% H_3PO_4. These acids revert slowly to orthophosphoric acid on dilution with water.
Hazard: Toxic by ingestion; strong irritant.
Use: Dehydrating, catalytic, and sequestering agents, for metal treating; many applications where a concentrated monooxidizing acid is needed; lab reagent. See also phosphoric acid.

polypropylene. CAS: 9003-07-0. $(C_3H_5)_n$
A synthetic, crystalline, thermoplastic polymer with molecular weight of 40,000 or more.
Note: Low molecular weight polymers are also known which are amorphous in structure, and used as gasoline additives, detergent intermediates, greases, sealants, and lube-oil additives. Also available as a high melting wax.
Derivation: Polymerization of propylene with a stereo-specific catalyst such as aluminum alkyl.
Properties: Translucent, white solid with d 0.90; mp 168–171C; tensile strength 5000 psi; flexural strength 7000 psi; usable up to 121C. Insoluble in cold organic solvents; softened by hot solvents. Maintains strength after repeated flexing. Degraded by heat and light unless protected by antioxidants. Readily colored; good electrical resistance; low water absorption and moisture permeability; poor impact strength below −9.4C; not attacked by fungi or bacteria; resists strong acids and alkalies up to 60C, but is attacked by chlorine, fuming nitric acid, and other strong oxidizing agents. Combustible, but slow-burning. Fair abrasion and good heat resistance if properly modified. Can be chrome-plated, injection- and blow-molded, and extruded.
Available forms: Molding powder: extruded sheet, cast film (1–10 mils), textile staple and continuous filament yarn, fibers with diameters from 0.05 to 1 μm and fiber webs down to 2 μm thick, low-density foam.
Use: Packaging film; molded parts for automobiles, appliances, housewares, etc.; wire and cable coating; food container closures; coated and laminated products; bottles; artificial grass and turfs; plastic pipe; wearing apparel (acid-dyed); fish nets; surgical casts; strapping; synthetic paper; reinforced plastics; nonwoven disposable filters.

polypropylenebenzene. See dodecylbenzene.

polypropylene, chlorinated. White, odorless, non-flammable powder. A film-forming polymer used in coatings, inks, adhesives, and paper coatings.

polypropylene glycol ester. Exactly analogous to polyethylene glycol ester.

polypropylene glycol monobutyl ether. See butoxy polypropylene glycol.

polypropylene glycol. (PG). $HO(C_3H_6O)_nH$.
One of a group of compounds comparable to polyethylene glycols but more oil-soluble and substantially less water-soluble. Classified by molecular weight as 425, 1025, 2025. Non-volatile, noncorrosive liquids; lower molecular weight members are soluble in water. Solvents for vegetable oils, waxes, resins. Combustible.
Use: Hydraulic fluids, rubber lubricants, antifoam agents, intermediates in urethane foams, adhesives, coatings, elastomers, plasticizers, paint formulations, lab reagent.

polypropyleneimine. Polymeric form of propyleneimine. Available in 50% aqueous solution.
Use: Textile, paper, and rubber industries.

polypropylene oxide. $(C_3H_6O)_n$. A derivative of propylene.
Use: Intermediate for urethane foams.

polypyrrolidone. Synonym for nylon-4.

"Polyrad" [*Aqualon*]. TM for reaction products of "Amine D" and ethylene oxide.
Grade: Various grades which differ in chain length of polyoxyethylene units and free amine content. Vary in viscosity at 25C from 0.5–24.8 poises.
Use: Corrosion inhibitors and detergents in petroleum processing equipment, wetting and emulsifying agents, inhibiting hydrogen chloride.

"Polyram" [*FMC*]. TM for a wettable powder.
Hazard: Toxic by ingestion and inhalation.
Use: Fungicide approved for many vegetables.

polyrotaxames. Hoop-like molecules threaded as "rotors" on a linear polymer "axle." Up to 40 α-cyclodextrim (rotor) molecules have been threaded on a poly(iminooligomethylene) (hub) chain.

polysaccharide. A combination of nine or more monosaccharides, linked together by glycosidic bonds. Examples: starch, cellulose, glycogen.
See also carbohydrate, phycocolloid.

polysiloxane. See siloxane.

"Poly-Solv" [*Olin*]. TM for a series of glycol ether solvents for paints, varnishes, dry-cleaning soaps, cutting oils, insecticides.

polysorbate. (USAN name for a polyoxyethylene fatty acid ester). One of a group of nonionic surfactants obtained by esterification of sorbitol with one or three molecules of a fatty acid (stearic, lauric, oleic, palmitic) under conditions which cause splitting out of water from the sorbitol, leaving sorbitan. About 20 moles of ethylene oxide per mole of sorbitol are used in the condensation to effect water solution.
Properties: Lemon to amber, oily liquids; d 1.1; faint odor and bitter taste; most types are soluble in water, alcohol, and ethyl acetate. Combustible.
Grade: Polysorbate 20 (polyoxyethylene (20) sorbitan monolaurate). Polysorbate 60 (polyoxyethylene (20) sorbitan monostearate). Polysorbate 80 (polyoxyethylene (20) sorbitan monooleate). Polysorbate 65 (polyoxyethylene (20) sorbitan tristearate).
Use: Surfactant, emulsifying agent, dispersing agents, shortenings and baked goods, pharmaceuticals, flavoring agents, foaming and defoaming agents.
See also sorbitan fatty acid ester.

polystyrene. CAS: 9003-53-6. $(C_6H_5CHCH_2)_n$.
Polymerized styrene, a thermoplastic synthetic resin of variable molecular weight depending on degree of polymerization.
Properties: Transparent, hard solid; high strength and impact resistance; excellent electrical and thermal insulator. Attacked by hydrocarbon solvents but resists organic acids, alkalies, and alcohols. Not recommended for outdoor use, as unmodified polymer yellows when exposed to light, but light-stable modified grades are available. Easily colored, molded, and fabricated. Copolymerization with butadiene and acrylonitrile and blending with rubber or glass fiber increase impact strength and heat resistance; autoign temp 800F. Combustible.
Derivation: Polymerization of styrene by free radicals with peroxide initiator.
Forms: Sheet, plates, rods, rigid foam, expandable beads or spheres.
Hazard: As for foam, plastic.
Use: Packaging, refrigerator doors, air conditioner cases, containers and molded household wares, machine housings, electrical equipment, toys, clock and radio cabinets. (As foam): thermal insulations, light construction as in boats, etc., ice buckets, water coolers, fillers in shipping containers, furniture construction. (As spheres): radiator leak stopper.
See also "Styron", "Styrofoam."

polysulfide elastomer. A synthetic polymer in either solid or liquid form obtained by the reaction of sodium polysulfide with organic dichlorides such as dichlorodiethyl formal, alone or mixed with ethylene dichloride. Outstanding for resistance to oils and solvents and for impermeability to gases. They have poor tensile strength and abrasion resistance, but are resilient and have excellent low-temperature flexibility. Some grades have fairly strong odor, which is not objectionable in most applications. Sealant grades are furnished in two parts, which cure at room temperature when blended.
Use: Gasoline and oil-loading hose, sealants and adhesive compositions, binder in solid rocket propellants, gaskets, paint spray hose.
See also "Thiokol."

polysulfone. A synthetic thermoplastic polymer.
Properties: Hard, rigid, transparent solid. Tensile strength 10,000 psi, d 1.24, flexural strength 15,000 psi, good electrical resistance, minimum creep, low expansion coefficient. Soluble in aromatic hydrocarbons, ketones, and chlorinated hydrocarbons; resistant to corrosive acids and alkalies, to heat and oxidation and to detergents, oils, and alcohols. Dimensionally stable over temperature range −100 to +148C; tends to absorb moisture, readily processed and fabricated. Combustible, but self-extinguishing.
Derivation: Condensation of bisphenol A and dichlorophenyl sulfone.
Use: Power-tool housings, electrical equipment, extruded pipe and sheet, auto components, electronic parts, appliances, computer components, base matrix for stereotype printing plates.

polyterpene resin. A class of thermoplastic resins or viscous liquids of amber color, obtained by polymerization of turpentine in the presence of catalysts such as aluminum chloride or mineral

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